

APPENDIX B

Performance Metrics for Intelligent Systems

Workshop Schedule

**General Chair – Elena Messina
Program Chair – Alex Meystel**

August 14 - 16

The Workshop opens in Lecture Room A, Bldg. 101

Afternoon Plenary Lecture will be conducted at Green Auditorium

**N I S T
Gaithersburg, MD
2000**

Advisory Board

- G. Adorni, University of Parma, Italy
- J. Albus, NIST, USA
- P. Antsaklis, University of Notre Dame, USA
- M. Asada, Osaka University, Japan
- G. A. Bekey, University of Southern California, USA
- K. Bellman, Aerospace Integration Science Corp., USA
- J. G. Blitch, DARPA, USA
- H.-H. Bothe, Technical University of Denmark, Denmark
- B. Chandrasekaran, Ohio State University, USA
- J. Cherniavsky, NSF, USA
- M. Cotsartis, LTME/ECE, France
- F. Darema, NSF, USA
- P. Dario, Scuola Superiore, Italy
- P. Davis, RAND Graduate School, USA
- G. Doebele-Henish, Knowbotic Systems, Germany
- J. Fetzer, University of Minnesota, USA
- D. Filev, Ford, USA
- R. Finkelstein, Robotic Technology, Inc., USA
- D. Fogel, Natural Selection, Inc., USA
- N. Foo, University of New South Wales, Australia
- W. Freeman, University of California at Berkeley, USA
- E. Fromm, Drexel University, USA
- T. Fukuda, University of Nagoya, Japan
- R. Garner, Loebner Prize Winner for 1998 and 1999, USA
- G. Gerhart, US Army TACOM, USA
- E. Grant, CRIM, North Carolina State University, USA
- S. Grossberg, Boston University, USA
- R. Gudwin, State University of Campinas, Brazil
- W. Hamel, University of Tennessee, USA
- W. Hargrove, Oak Ridge National Laboratory, USA
- E. Horvitz, Microsoft Research, USA
- M. Jabri, University of Sydney, Australia
- D. Jaron, Drexel University, USA
- R. Jordan, Lockheed Martin, USA
- C. Joslyn, Los Alamos National Laboratory, USA
- S. Kak, Louisiana State University, USA
- H. Kitano, Sony Computer Science Labs, Japan
- K. Kreutz-Delgado, University of California at San Diego
- F. Kurfess, Concordia University, Canada
- J. E. Laird, University of Michigan, USA
- C. Landauer, Aerospace Integration Science Corp., USA
- S. Lee, Samsung Advanced Inst. of Technology, Korea
- C. S. George Lee, Purdue University, USA
- D. Lenat, Cycorp, USA
- P. B. Luh, University of Connecticut, USA
- B. Mirkin, Birkbeck College, GB
- R. Morris, NIST, USA
- T. Parisini, Politecnico di Milano, Italy
- K. Passino, Ohio State University, USA
- L. Perlovsky, Innoverity, Inc., USA
- L. Pouchard, Oak Ridge National Lab, USA
- J. Pustejovsky, Brandeis University, USA
- L. Reeker, NIST, USA
- D. Repperger, AFRL/HECP, USA
- E. H. Ruspini, SRI International, USA
- T. Samad, Honeywell, USA
- A. Sanderson, NSF, USA
- R. Sanz, University of Madrid, Spain
- A. Schultz, Naval Research Laboratory, USA

- T. Shih, Tamkang University, Taiwan
 - R. Simmons, Carnegie-Mellon, USA
 - M. Swinson, DARPA, USA
 - M. Tilden, Los Alamos National Lab., USA
 - I. B. Turksen, University of Toronto, Canada
 - C. Weisbin, NASA, USA
 - T. Whalen, Georgia State University, USA
 - A. Wild, Motorola, USA
 - V. Winter, SANDIA, USA
 - J. Xiao, NSF, USA
 - R. Yager, Iona College, USA
 - A. Yavna, RAFAEL, Israel
 - Y. Ye, IBM T. J. Watson Research Center, USA
 - B. Zeigler, University of Arizona, USA
 - L. Zadeh, University of California at Berkeley, USA
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The Schedule of a Session

- Each Session is allotted 2 hours.
 - It is expected that a speaker will use a slot of 25 minutes for his/her presentation (20 minutes) and answering questions (5 minutes).
 - The remainder of time (20 minutes) should be used for a general discussion and combining the *Final Recommendations* of the Session.
 - The Final Recommendations of all sessions will be integrated into *Final Recommendations of the Workshop*.
 - The results of Each Day are discussed at the evening Plenary Discussion
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1st Day, Monday, August the 14th

First Day starts at 8.30 AM with introductory presentation:

J. Evans, E. Messina, Performance Metrics for Intelligent Systems

PLENARY LECTURE – 9 AM – 10 AM

H. Szu, Machine IQ with Stable Cybernetic Learning With and Without a Teacher

Coffee Break: 10 AM-10.30 AM

Sessions: 10.30 AM – 12.30 PM

I Day, morning A: Features of Industrial Intelligent Systems,

Co-Chairs: M. Cotsaftis, W. H. VerDuin

- M. W. Bailey, W. H. VerDuin, FIPER: An Intelligent System for the Optimal Design of Highly Engineered Products
 - S. A. Wallace, J. E. Laird, K. J. Coulter, Examining the Resource Requirements of Artificial Intelligence Architectures
 - C. Peterson, A Metric for Monitoring and Retaining Flight Software performance
 - M. Cotsaftis, On Definition of Task Oriented System Intelligence
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I Day, Morning B: Features of Living Intelligent Systems

Co-Chairs: K. Bellman, C. Joslyn

- K. Bellman, Understanding and Its Behavioral Correlates
 - C. Joslyn, Toward Measures of Intelligence Based On Semiotic Control
 - H. Sarjoughian, B. Zeigler, Model-based Design and Measurement of Intelligence
 - T. Chmielewski, P. Kalata, Biometric Techniques: The Fundamentals of Evaluation
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I Day, Morning C: Special Issues of Evaluating Intelligence

Co-Chairs: R. Sanz, A. Wild

- R. Sanz, I. Lopez, Minds, MIPs, and Structural Feedback
 - A. Wild, Using the Metaphor of Intelligence
 - R. Garner, R. N. Bishop, Applied Applications for Mimetic Synthesis: The AAMS Project Summary
 - H. M. Hubey, General Scientific Premises of Measuring Complex Phenomena
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Lunch 12.30 PM – 2 PM

PLENARY LECTURE – 2 PM-3 PM

G. Saridis, Definition and Measurement of Machine Intelligence

Coffee Break: 3 PM-3.15 PM

Sessions: 3.15 PM – 5.15 PM

I Day, Afternoon A: Metrics and Comparison of Alternatives: General Issues

Co-Chairs: L. Pouchard, W. C. Stirling

- L. Pouchard, Metrics for Intelligence: the Perspective from Software Agents
- J. Spall, et al, Towards an Objective Comparison of Stochastic Optimization Approaches
- W. C. Stirling, R. L. Frost, Intelligence with Attitude
- S. Lee, W.-C. Bang, and Z. Z. Bien, Measure of System Intelligence: An Engineering Perspective

I Day, Afternoon B: Metrics and Comparison of Alternatives: Case Studies

Co-Chairs: R. Finkelstein, E. Grant

- E. Grant, G. Lee, Properties of Learning Knowledge Based Controllers
- V. Grishin, A. Meystel, Using Visualisation for Measuring Intelligence of Constructed Systems
- R. Finkelstein, A Method for Evaluating the IQ of Intelligent Systems
- L. Polyakov, In Defense of the Additive Form for Evaluating Vectors

Plenary Discussion- 5.15 PM – 6.15 PM

Panel: K. Bellman, M. Cotsaftis, R. Finkelstein, E. Grant, C. Joslyn, C. Peterson, L. Pouchard, W. C. Stirling, A. Wild

8 PM – Meeting of the Advisory Board (at "Holiday Inn")

2nd Day, Tuesday, August the 15th

PLENARY LECTURE – 9 AM-10 AM

J. Albus, Features of Intelligence Required in Unmanned Autonomous Vehicles

Coffee Break: 10 AM-10.30 AM

Sessions: 10.30 AM – 12.30 PM

II Day, Morning A: Measuring performance

Co-Chairs: A. Sanderson, T. Samad

- T. Samad, Technologies for Engineering Autonomy and Intelligence
 - A. Sanderson, Minimal Representation Size Metrics for Intelligent Robotic Systems
 - J. Zhang, A Formal Method to the Performance Metrics for Engineering Systems
 - R. Yager, A Hierarchical Framework for Constructing Intelligent Systems Metrics
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II Day, Morning B: Modeling and Measuring Machine Intelligence

Co-Chairs: P. Davis, T. Whalen

- P. Davis, Exploratory Analysis Enabled by Multiresolution, Multiperspective Modeling
 - M. Jabri, Measuring intelligence: a neuromorphic perspective
 - I. Nourbakhsh, Two measures for measuring the 'intelligence' of human-interactive robots in contests and in the real world: perceptiveness and expressiveness
 - T. Whalen, What is the Value of Intelligence and How Can It Be Measured?
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II Day, Morning C: Evaluating Factors of Intelligence in Systems

Co-Chairs: J. Hernandes-Orallo, C. Peterson

- J. Hernandes-Orallo, On the Computational Measurement of Intelligence Factors
 - A. Wild, Heterogeneous Computing
 - J. Bryson, et al, Hypothesis Testing for Complex Agents
 - T. Balch, Hierarchic Social Entropy: An Information Theoretic Measure of Robot Group Diversity
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Lunch 12.30 PM – 2 PM

PLENARY LECTURE – 2 PM – 3 PM

S. Grossberg, Some Constraints on Intelligent Systems:

Autonomous Computation in a Changing World

Coffee Break – 3 PM – 3.15 PM

Sessions: 3.15 PM – 5.15 PM

II Day, Afternoon A: Measuring of Intelligence of Multiagent Networks

Chair and Organizer: S. Phoha

- R. R. Brooks, STIGMERGY: A measure of intelligence for emergent distributed behaviors
 - S. Phoha, D. Friedlander, Goodness of Fit Measures for Intelligent Behaviors of Interacting Machines
 - M. E. Cleary, M. Abramson, M. B. Adams, S. Kolitz. Metrics for Embedded Collaborative Intelligent Systems
 - D. Friedlander, S. Phoha, A. Ray, Domain Independent Measures of Intelligent Control
 - S. Perraju Tolety, G. Uma, On Measuring Intelligence in Multi-Agent Systems
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II Day, Afternoon B: Evaluating Intelligent Systems by Testing and Competition: Benchmarks

Co-Chairs and Organizers: A. Schultz, R. Murphy

- A. Schultz, Evolution of Metrics for Mobile Robots
 - A. Jacoff, E. Messina, J. Evans, A Standard Test Course for Urban Search and Rescue Robots
 - R. Murphy, J. Casper, M. Micire, J. Hyams, Assessment of the NIST Standard Test Bed for Urban Search and Rescue Competitions
 - T. Balch, Performance/N is the Wrong Metric for Multirobot Teams
 - S. K. Agrawal, A. M. Ferreira, S. Pledgie, Performance Evaluation of Robotic Systems: A Proposal for a Benchmark problem
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II Day, Afternoon C: Measuring Intelligence of Distributed Systems

Co-Chairs: R. Fakory, W. J. Davis

- W. J. Davis, Evaluating Performance of Distributed Intelligent Control System
 - R. Fakory, M. Jahangiri, Real Time Distributed Expert System for Automated Monitoring of Key Monitors in Hubble Space Telescope
 - X. Qin, A. E. Aktan, Distributed Internet-Based Multi-Agent Intelligent Infrastructure System
 - D. P. Gravel, W. S. Newman, Flexible Robotic Assembly
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Plenary Discussion- 5.15 PM – 6.15 PM

Panel: T. Balch, P. Davis, W. J. Davis, R. Fakory, J. Hernandes-Orallo, R. Murphy, S. Phoha, T. Samad, A. Sanderson, A. Schultz, T. Whalen

Evening: COCKTAILS AND BANQUET **– 6.45 PM at "Holiday Inn"**

L. Zadeh,
Banquet speech "The Search for Metrics of Intelligence -- A Critical View."

3rd Day, Wednesday, August the 16th

PLENARY LECTURE – 9 AM – 10 AM

W. Freeman, The neurodynamics of intentionality in animal brains provides a basis for constructing devices that are capable of intelligent behavior

Coffee Break: 10 AM-10.30 AM

Sessions: 10.30 AM – 12.30 PM

III Day, Morning A: Measuring Intelligence Taking in Account Linguistic, Psychological and Biological Factors

Co-Chairs: L. Reeker, A. Meystel

- L. Reeker, Theoretical Constructs for Measurement Performance and Intelligence
 - A. Meystel, Generalizing Natural Language Representations for Measuring the Intelligence of Systems
 - P. Wang, Machine Intelligence Ranking
 - A. Treister-Goren, J. Dunietz, The AI Language Development Metric
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III Day, Morning B: Measuring Intelligence of Systems with Autonomy and Mobility

Co-Chairs: G. S. Sukhatme, J. Weng

- G. S. Sukhatme, Measuring Mobile Robots Performance: Approaches and Pitfalls
 - L. E. Parker, Evaluating Success in Autonomous Multi-robot Teams: Experience of ALLIANCE Architectures Implementation
 - A. Lacaze, S. Balakirsky, Search Graph Formation for Minimizing the Complexity of Planning
 - J. Weng, Automatic Mental Development and Performance Metrics for Intelligent Systems
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Lunch 12.30 PM – 2 PM

PLENARY LECTURE – 2 PM – 3 PM

**A. Meystel , Evolution of Intelligent Systems Architectures:
What Should Be Measured**

Coffee Break – 3 PM – 3.15 PM

Afternoon Session – 3.15 PM – 5.15 PM

III Day, Afternoon (Plenary Panel): Perspectives of Governmental Programs on Measuring Intelligence

Panel organizers – J. Albus, J. Blitch, J. Evans

- J. Albus, NIST
 - J. Blitch, DARPA
 - J. Evans, NIST
 - C. Shoemaker ARL,
 - C. Weisbin, NASA
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General Discussion of the Workshop Results- 5.15 PM – 6.15 PM

Panel: J. Albus, J. Evans, E. Messina, A. Meystel, L. Reeker, G. S. Sukhatme, J. Weng

The Meeting is adjourned 6.15 PM